BIBLIOGRAPHICAL NOTICES.

Manual of Geology, Theoretical and Practical. By John Phillips, LL.D., F.R.S. In Two Parts.—Part I. *Physical Geology and Palæontology.* By Harry Govier Seeley, F.R.S. With Tables and Illustrations. 8vo. Pp. xiv and 546. London: Charles Griffin & Co., 1885.

This is preeminently the age of geological text-books. Within the past few years we have had most elaborate manuals from two of the leading geologists on either side of the Atlantic, to say nothing of several excellent text-books from the pens of other writers. From time to time also the standard works of Lyell and of Murchison have been brought up to date. But, until the present work came out, no one thought of bringing the manual of the late Prof. Phillips into line with the modern advance of the science. Some may have thought the experiment a dangerous one, savouring, it might be, of putting new wine into old bottles, with the usual risk to both attendant on the process.

Despite the great advances which have been made in geological studies during the last thirty years, the general principles and philosophy of geology had been pretty well laid down by the year 1855, which was the date of the last edition of this work. Hence the author of the present volume (Physical Geology and Palæontology) has done well to retain every page of the original work which appeared to him in any way valuable, so that the spirit of the old book might be preserved. The late Professor Phillips had a wonderfully pleasant way of putting things, and it would scarcely have been doing justice to his philosophy and erudition to have omitted more than was absolutely necessary except in those cases (inevitable in a growing science) where subsequent investigation had shown that he was not quite correct in his conclusions.

"In endeavouring to sustain that part of the titlepage which describes the manual as *theoretical*," Professor Seeley says, "I have drawn to some extent upon theoretical views enunciated in my lectures during the ten years from 1860 to 1870, for which Professor Sedgwick deputed to me the practical teaching of Physical Geology and Palæontology in the University of Cambridge. . . . . The work will be found *practical* too; for it aims throughout, by indicating localities where phenomena may be seen, at enabling every one to verify, and study in nature, the statements and ideas which are herein set forth."

As an appropriate introduction to Physical Geology we have a chapter on the earth's density, shape, structure, and origin. A useful *résumé* of the leading facts bearing on these points is given, the last subject conducting inevitably to cosmical speculation. The author, bearing in mind that he is writing for students, speaks of Mr. Croll's climate-in-time theory, which is based on the excentricity of the earth's orbit, as an hypothesis, which on astronomical grounds is speculative, but not impossible, and deserving of atten-

tion. The inferences derived from the study of meteorites are not without interest; since, in truth, these bodies seem to be messengers sent direct from Kosmos.

Chapters III. to VIII. inclusive deal with the rocks from a lithological and petrological point of view. Dismissing the subject of chemistry with extreme briefness, and not entering into that of crystallography at all, the author details (1) the mineral substances which constitute the *aqueous rocks*, and (2) those which form the *igneous rocks*, in a series of very useful tables. The principal rock-forming minerals are divided into family groups, which have a certain naturalness, although such grouping might not in all cases suit a fastidious mineralogist.

Next comes the "nature and origin of crystalline and igneous rocks," and the "nature, composition, and origin of water-formed rocks." In dealing with the first Prof. Seeley adopts what may be termed the views of the metamorphic school; but when he speaks of the easy solubility of carbonate of lime in heated water as one of the agents of such changes he appears to have left out the carbonic acid. In a somewhat similar way he tells us that "clay, slate, gneiss, granite, felstone, rhyolites may exist simultaneously as different conditions of the same rock." There are not many clays that would make a rhyolite, we apprehend, without more of the solid protoxide bases than usually belongs to clays. The primary divisions of Basic and Acidic are artificial, but convenient. He divides all igneous rocks into those which contain orthoclase and those which contain plagioclase, further subdividing each into quartz-bearing and quartz-free. Under this arrangement the olivine-enstatite rocks or peridotites would seem to have no location. The author is disposed to believe that the materials of igneous rocks were originally the materials of stratified formations: the sorting power of water gives a different composition to every mile of a formation as it recedes from the shore. When all this was melted up the parts nearest the land would yield acidic rocks, the parts more distant from land would form the so-called basic rocks. Previously (p. 35) he was disposed to regard the separation as in part effected by the solvent action of water. Doubtless both causes may exercise an influence in bringing about this singular result, for which Durocher was obliged to suppose two separate magmas.

Coming now to the water-formed rocks, Prof. Seeley says that clay has very nearly the same composition as the mineral felspar. Surely not! The alkalis have in the main been removed. This is a most important difference, and one which bears upon the questions previously discussed. Kaolin rather than felspar must be regarded as the basis of most clays. Under the head of Limestones the author states that the oolite of the Secondary rocks was due to evaporation at the surface of the sea, so that a film was formed round some shell-fragment, which continued to increase in size as it fell through the water till it sank to the bottom. This explanation, he says, will also account for the uniform size of the grains in the same stratum. As a rule, the amount of calcium salts in the

water of existing seas is small, so that, unless the Jurassic seas were differently constituted in this respect, the granules must have fallen through an immense depth before a mere film could have become an oolitic grain. All evidence, such as that of reef-building corals &c., goes to show that the oolitic seas were shallow, at least in England. This chapter terminates with a table of the chief British strata, with indications of the prevalent mineral character of the beds, &c. This is a useful table, though the major divisions are very unequal. For instance, the Trias, Permian, and Carboniferous are undivided, but the Jurassic system is split up into Lias, Lower Oolites, Pelolithic, and Psammolithic (part), an arrangement which few teachers would recommend to their pupils. The fact is that Professor Seeley is a law unto himself, a kind of geological nonconformist; and in this instance he seems to have taken a pleasure in defying the rules of the International Geological Congress.

Under the heading of "Petrology" he deals with the phenomena of stratigraphy, and under that of "The Physical and Mineral History of Stratified Rocks" he again discusses the subject of sands, clays, limestones, &c., not forgetting such concretionary bodies as flints. A short chapter on coral-reefs closes this section of Physical Geology.

The two succeeding chapters deal with Physiographic Geology, including the study of coast-lines and their origin, and the general features of scenery in their relation to geological phenomena: and this again leads, in a third chapter (xi.), to that part of dynamic geology which relates to the action of water in modelling the outer crust of the earth. There is probably no more interesting branch of geological science than this, certainly none more popular. Although much is theoretical, especially when we come to deal with subjects of past geographies, yet there is so much that is practical about it, that almost every intelligent tourist can, up to a certain point, make some portion of this branch of the science his own. Professor Seeley gives a sketch of the physical history of the British Islands and the Channel, and treats generally of the origin of geographical features, such as islands, plains, valleys, &c.

As the origin of lakes has given rise to much discussion in recent years, it may not be without interest to note the views of an author like Professor Seeley on the points involved:—(1) "Nearly all the great lakes of the world," he says (p. 134), "owe their existence to direct upheaval of the ocean floor." As instances he gives the great Russian lakes Ladoga and Onega, which are merely prolongations of the Gulf of Finland, leading northward to the White Sea, and are the remains of a channel partly dried up. Consideration of the lakes of Central Asia, many of which are salt from evaporation, serves to demonstrate how recent the last elevation of the country from the sea has been. Lake Baikal is a freshwater lake, yet it contains a large number of salt-water types of animals. Hence it may be concluded that Lake Baikal was originally a portion of the great Central-Asian sea, and was one of the deepest pools in its bed, previous to the elevation of the mountain-axis of the old world.

(2) A second group of lakes has been produced as a consequence of compressions which have thrown the rocks into parallel folds on a smaller scale; when these are closed by tilting, so as to have no outlet for the drainage, fiord-like lakes, such as those on the west coast of Scotland and elsewhere, are the result. (3) A third group is also exemplified by some in Scotland, where the waters lie along anticlinal folds or saddles. (4) The fourth group of lakes comprises those which have been excavated by ice; some are dammed up at their lower end, but others lie in depressions excavated in the solid rock. Several of the lakes of Cumberland, he says, are susceptible of explanation in this way. A very neat woodcut representing Grasmere adorns this page, whence we may suppose that Professor Seeley regards this lake as a case in point. But no allusion is made in the text to the figure, and this practice obtains occasionally throughout the book.

A very large portion of the manual is devoted to volcanic phenomena. After a sketch of the nature and origin of volcanic energy, the author records the manifestations of volcanic action, and then he plunges once more headlong into the rocks. Chapter XIV. Nature and Origin of Igneous Rocks. Chap. XV. The Granitic or Plutonic Group of Rocks. Chap. XVI. History of British Plutonic Rocks. Chap. XVII. The History of Volcanic Rocks. By no means the least interesting chapter in the book is that devoted to the history of volcanic activity in Britain. The literature of this subject, one may say, is peculiarly the growth of the last twenty years or even less, so that many rocks, whose nature was unknown in the days of Prof. Phillips, are now recognized as having had a volcanic origin. The pre-Cambrian volcano of St. David's has the place of honour at the head of the list, and the great volcanic masses of Lower Silurian age (Cambrian according to Prof. Seeley's classification) in North Wales and the Lake District are duly recorded, whilst Scotland and Cornwall appear to have been the principal seats of volcanic forces in Devonian times. Scotland was again uneasy during portions of the Carboniferous epoch. The Secondary period was not one of marked vulcanicity in these islands, though there are many interesting volcanic rocks near Exeter and in other parts of Devonshire associated with the Triassic strata of that county. The Tertiary volcanic rocks of the north of Ireland and west of Scotland and their results are dealt with in the concluding portions of the chapter.

After stating some of the results of volcanic energy from a dynamical point of view, Prof. Seeley for the third time plunges into the rocks. Accordingly we have a chapter on metamorphism, and one on the distribution of gneiss and mica-schist; and he concludes the section of physical geology with the history of mineral veins, and an account of the chief mineral deposits in Britain. Under the head of British copper-mines we note that the "Carboniferous Limestone" of Parys Mountain in Anglesey has long been productive of copper. The age of the strata in Parys Mountain may still be a matter of dispute; but this is the first time we ever heard of those

beds being referred to the Carboniferous Limestone. The views of Daubrée as to the origin of cassiterite and its associated minerals are quoted at some length.

Physical Geology, of which a brief and inadequate notice has been given above, occupies 436 pages of the entire volume, and no small portion of this, as we have seen, is devoted to the more intimate study of the rocks. Prof. Seeley has, in fact, been deeply bitten by that love of petrology (using this term also to include lithology) which is so characteristic of the present day. We notice here (as, indeed, throughout the whole of this portion of the work) the results of diligent and careful inquiry carried on in a philosophical and unbiassed spirit. Some critics might perhaps demur to the general arrangement as being rather complex; but of the excellence of a large portion of the matter there can be no doubt. Considering that the chief scope of Prof. Seeley's studies has hitherto lain in quite another direction, his grasp of petrological questions is remarkably good. It would be most ungenerous not to admit this to the full, even though some unimportant errors may be demonstrable.

The two remaining chapters are devoted to Palæontology, concluding with a review of the succession of animal life. As may be supposed, this portion of the work is full of interest, though parts of it read more like an essay than a text-book. In common with most modern authors, Prof. Seeley considers that existing creatures are the descendants of a long chain of preexisting creatures, and thus Palæontology becomes the history of the succession of life on the earth. "It begins with a remote past, when the great groups of organisms were already characterized, and many surviving genera were in existence."

Dealing with the question of the "Origin of Species," he points out the logical defect in Darwin's original argument, since that author did not explain the cause of structural variation. Prof. Seeley claims that as far back as 1862 he had already indicated, in the 'Transactions of the Cambridge Philosophical Society,' that the fundamental active principle in evolution is physiological causation, which, though not uninfluenced by external conditions, is more dependent upon circumstances of function. This view has of course presented itself to most biologists, and some have gone even further to the length of expressing their surprise that, on the whole, the process of structural change has been so slow throughout the successive ages—so slow, indeed, that some existing forms are almost identical with those of a tolerably remote past. This subject is well treated of under the head of "Persistent Types of Life." The author considers that the direction of physiological variation is always towards increased complexity of structure; but the direction of variation under external influences is often towards increased simplicity of structure. Hence, apparently, the two tendencies serve partly to balance each other.

The author, bearing in mind that he is writing a text-book, observes that "every fossil, like every plant and animal, must be referred to its 'genus' and 'species,' and we need to have clear

ideas of the nature of the facts indicated by these terms." He even defines a "genus," and illustrates the definition by reference to the characteristics of certain genera of Lamellibranchs, showing their mutual relations. We do not find, however, that he has ventured on the definition of "species." The fact is that, when once the doctrine of evolution is admitted in all its entirety, the ideas attaching to such expressions as "genus" and "species" lose somewhat of their definition. Nevertheless they are necessities in classification; and even if they do not absolutely exist in nature, it becomes necessary, as by a sort of legal fiction, to presume that they do exist, for purposes of scientific arrangement. But the palæontologist has to deal with the element of time in addition to his other difficulties, and thus for him, far more than for the simple student of recent life, does it become necessary not to place too rigid a definition on "genus" and "species." There are occasions when we must dare to be illogical.

After describing some of the varieties of deposit, Prof. Seeley discusses the phenomena attendant upon Life, such as its succession in time, migration, the origin of faunas, extinction of species, homotaxis, &c., concluding with an account of the existing distribution of life, and the relations of living to fossil forms. Of the collateral subjects in this connexion he alludes to the climatal conditions of ancient seas, which he considers must rest on physical evidence. "Ice-scratched stones, glaciated rocks, and boulder-clay may prove conditions of great cold; but we are acquainted with no physical evidence that would demonstrate heat as a climatic condition of the earth." This may be so, but surely there exists biological evidence of temperature in the presence of reef-building corals, which now require an isochryme not lower than 69° F. Such an inference has been held legitimate by Prof. Dana, in common with most geologists; and it is certainly a singular coincidence that a life assemblage presenting some analogies with that of the Jurassic should, at the present day, be found in and about Australia, where reef-builders abound. Prof. Seeley is a bit of an iconoclast, and few things give him more pleasure than to upset, or try to upset, a prevalent belief. We say nothing about such a case as that of the Stonesfield mammals, for it is in dealing with the Mammalia that the most erroneous inferences as to climate have been drawn, as is very aptly pointed out by the author in the case of the mammalian remains of our valley-gravels.

Finally, we are presented with a brief abstract of the succession of life on the earth in geological time—not the least useful portion of the entire volume, and certainly the most suitable for a manual, since there is a great amount of condensed information well brought up to date, and less of the theoretical than elsewhere. The figures too are instructive and germane to the subject. It is almost unnecessary to add that the portion devoted to the Vertebrata is particularly good.

Many of the views which have been developed and perfected in the present work were originally brought forward by the author in

the 'Annals.' From early days he gave evidence of a powerful and eminently original genius, and he has continued to develop on these lines until he has arrived at his present eminent position as a practical geologist and philosophic writer. We may confess to a suspicion that such a high-stepper is not best seen in the harness of a text-book: nevertheless the present work is full of instructive matter, whilst the philosophical spirit which it displays will doubtless charm many a reader. No one has shown more convincingly than the author that, in all ways, the past contains within itself the interpretation of the existing world—a truth which biologists should lay to heart. At the same time the geographer is taught to seek an explanation of existing phenomena in the physical revolutions (not necessarily catastrophes) of successive ages.

On a Method to be followed in Prehistoric Studies. [*Sur une Méthode à suivre dans les Etudes Préhistoriques.*] By Eugène van Overloop. 8vo. 114 pp., with three Maps. Brussels: Muquardt, Merzbach, and Falck, 1884.

In this interesting memoir, dedicated to the Anthropological Society of Brussels, the author insists upon the recognition of the natural surroundings of early man being highly necessary for a knowledge of his ways and habits, and quite indispensable, however much a study of his stone implements and their probable uses may help the inquirer. To this end he has applied himself to a careful examination of a special district, where such relics of prehistoric (or, as he prefers, "premetallic") people are abundant—namely, a part of Flanders to the east of the Terneuzen Canal (Canal de Terneuse).

The general flatness of this country and the complicated intersection of its streams and waterways have not hindered M. van Overloop in his work. Using the ordnance-survey or military map of the district (pl. i., on a scale of $\frac{1}{10000}$), to some extent, with its contour-lines and other indications of the existing condition of the country, the author has carefully examined this particular region (of about 4000 hectares), and mapped the higher grounds as distinct from the alluvial flats (pl. ii., scale $\frac{1}{10000}$), and marked the spots (always on one or other of the plateaus or patches of rising ground) where stone implements have been found. In this he has also judged for himself, by the consideration of natural features, geological characters, the modes of cultivation and occupation, and the run of former channels of the natural drainage, as recorded in old maps and histories. He has also carried his observations on the altered river-courses further to the south-west, and a portion of the national map (scale $\frac{1}{160000}$) is appended for reference. The actual condition of the fauna and flora, forests and marshes, dry land and rivers, wild beasts, birds, and fisheries of the district under notice in early historic times, as noticed in old writings, is detailed; and what was known of the former population by the Romans and others is carefully noted.